THE

AMERICAN JOURNAL

OF THE MEDICAL SCIENCES.

SEPTEMBER, 1890.

A CASE OF BRAIN TUMOR (ANGIOMA CAVERNOSUM), CAUSING SPASTIC PARALYSIS AND ATTACKS OF TONIC SPASMS. OPERATION.

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The following case is one that has been described as atypical myotonia, non-congenital, by Dr. A. B. Shaw, and as neuro-myotonia by Dr. Ch. Hughes, in the *Alienist and Neurologist*, January, 1890.

The patient was exhibited, and the disease discussed at length in the St. Louis Medical Society in the month of November, 1889. The opinions expressed on this occasion as to the nature of the trouble were widely divergent.

The patient was an inmate of the Poor-house, and was, for the purpose of more convenient and exhaustive study, removed to the St. Louis Polyclinic building, where I, with quite a number of medical gentlemen, saw and observed him for several weeks.

The following represents in substance my remarks at a meeting of the Medico-Chirurgical Society held February 18, 1890. The patient was present on that occasion.

Joseph McE. is about twenty-three years old, and was, up to three years ago, in good health. Inquiries as to heredity, syphilis, plumbism, etc., give a negative result.

The history of the case he relates in a uniform manner, and without any material contradictions, as follows: About three years ago, while working in a mining mill, and feeling perfectly well, he was suddenly seized with a spasm in the left arm, which was drawn across the breast and upward, so that the clinched hand was resting on the clavicle. His arm was "locked" so that he could not remove a pipe which he was smoking at the time from his mouth. At the same time, he avers, there was a slow movement of the head from side to side. (In regard to any implication of the facial muscles his testimony is unreliable.) He felt "miserable all over" at the time, but at the end of a few minutes the spasm relaxed, and he continued to work as if nothing had happened. The same occurrence took place five hours later, while at breakfast. From this day on he had two spasms every day for about a year, when they increased in frequency.

For six weeks after the inception of the trouble he continued to work, being interrupted only when the spasms came on. At the end of this time the toes of his left foot "turned down" so that his walk became interfered with. There was now a weakness in the left foot; he began to limp; but, although the toes pointed downward, he was still able, as he claims, to walk on the soles of his feet. When the foot was first involved his speech became affected, he could not speak as fluently as formerly, and stuttered. At the same time jerks in various parts of the body supervened. They were so violent at times that on various occasions he came near being thrown from the chair. At the time the spastic flexion took place in the toes of his left foot his head was drawn to the left side, and became fixed in this position. He could not move it to the right for two months, and whenever he wanted to look at an object to the right, which was not within his visual field, he had to turn his whole body on its axis, like a person with wry-neck.

Even while in this condition he was still able to do odd jobs about the house—chop wood, for instance. But it would happen to him that, after having raised the axe preparatory to bringing it down on an object with force and quickness, he was prevented from doing so. His arms remained stiff and immovable, with the handle of the axe clutched with the hands in the raised position, for half a minute or so.

Subsequently, at a time which he cannot fix accurately, but at any rate several months after the involvement of the left foot, the right one became implicated, its toes likewise turning down. But the left leg and foot were then, and ever afterward, the weaker of the two. In fact, his whole left side was weakened, besides being spastic.

With all this his general health continued good, his appetite and all the functions of the body remaining in a normal condition, with the exception of his stomach. Although he digested well, he vomited every morning from the onset of the trouble for three months. In the last two and a half years these vomiting spells have lessened in frequency; they came on about twice a week, and were independent of the character of the food he ate; nor were they accompanied by other symptoms of intestinal disturbance.

Having become absolutely unfit for work he came to St. Louis to seek medical aid at the Mullanphy Hospital. Failing in this he went to Philadelphia, where he was under observation and treatment in the Philadelphia Hospital, under Dr. Charles K. Mills. It seems that he left that place suddenly, after a short stay, for the West, entered again the St. Louis Mullanphy Hospital, and finally landed at the Poor-house of this city. This was sometime in the summer of 1889. His case had remained stationary, but in August, 1889, while at the Poor-house, the weather being extremely hot, he had an attack of great prostration, accompanied with persistent sleeplessness, nervousness, and increased spasms. These latter, whilst they were followed before by intermissions of about five minutes' duration when at their worst, now succeeded each other constantly, so that it was impossible for him to eat. Obstinate vomiting, and pains in the limbs brought about by the intense and uninterrupted contractions of the muscles, added greatly to his sufferings. After a week or so the attack passed off, and he was pretty much in the same condition he was in before, except that from this time on a new symptom developed, which consisted in periodical diarrhœa. His bowels became loose about once a week, and oftener whenever he underwent any unusual amount of bodily exertion.

The present state of the patient (three years after the inception of the disease) is as follows:

He is right-handed, five feet seven and a half inches in height, muscles well developed, general nutrition good. His speech is peculiar; there is no obvious flaw in phonation or articulation; no dropping of consonants, or syllables, or whole words; when he does speak he speaks perfectly, but hurriedly. But before he can begin a sentence it seems as if there were an obstacle to be overcome; this having been accomplished, he speaks rapidly, as if to make up for the time lost in overcoming the obstruction to utterance. There is never any hesitancy in pronouncing *yes*, *no*, or *well*. .The latter he is fond of using as a starter, a preparatory exercise for limbering up the muscles engaged in articulating the more difficult letters and words. He repeats it with increasing rapidity a great many times (I have counted as many as twelve times), interposing the letter "a" after this fashion: well-a, well-a, well-a, well-a, etc. The great stumbling-block in beginning a sentence is S, or sh. The difficulty becomes sometimes insurmountable, so that he has to give up all attempts at conveying his thought. He then, in quite a natural tone of voice, will excuse himself, saying: "Well, I can't say what I want to say." In this connection he pronounces the two "S" that occur in this sentence without any difficulty.

But in regard to this difficulty, and for that matter all the other symptoms presently to be described, he has his bad and good days. On the latter his answers are prompt, without any halt or interruption. Thus it happened that, when I undertook to exhibit the peculiarity of the patient's speech to Dr. S. Weir Mitchell, during a recent visit to St. Louis, I utterly failed, the patient answering all the questions put to him in the most natural and fluent manner possible.

In general he is slow to answer questions, a fact which gives the impression of mental hebetude. Whether there is any real impairment of the mental faculties is very hard to determine, since there is no relative or acquaintance who could compare his present mental state with the one before his ailment set in. A noteworthy feature in his mental condition is that he never begins a conversation; he lacks initiative; and it seems that an impetus from without is necessary to rouse him sufficiently to engage in conversation. He claims that this was always the case with him, that, as long as he can remember, he has been "a person of few words." On the whole it may be stated that, in spite of his grave affection, which for the last three years has so disabled him, that he has had to seek refuge in the Poor-house, he is not to any great extent depressed; there is, on the contrary, an element of optimism observable in his mental make-up. Though his answers to questions put to him are tardy, they are always to the point, and no flaw in his reasoning powers can be discovered. How much of his taciturnity is attributable to the disturbance of speech, and how much of a suspicion as to his mental condition is due to the weird appearance which his face and body present in consequence of often-repeated slow tonic contractions in the face, neck, and limbs, is hard to determine. Among his fellow-patients he passes as absolutely level-headed.

There seems to be, however, little doubt that he is very irritable. He claims that this has been the case only since the onset of the present trouble.

In engaging him in conversation, one is struck above all by the constant tendency of the head to turn to the left; presently his left arm moves, and he hooks with the index and third fingers flexed in the second and third phalangeal joints any available object within his reach in order to steady the arm. Meanwhile he fixes his eyes on the interlocutor, while his head turns slowly away from him. All this impresses the observer as extremely odd, and one is apt to misjudge his mental calibre.

He is unable to whistle, but claims that he never was a good whistler. He moves his tongue slowly from side to side, and dares not protrude it for fear that his jaws might close with a snap—an event which on a previous occasion caused him to bite his tongue severely. He grinds his teeth occasionally, but qualifies this as a bad habit. He masticates slowly, swallows ordinarily with ease, but at times he has to wait a number of seconds before the bolus can be pushed beyond the pharynx. The eyes are moved slowly from side to side, somewhat more rapidly, it seems, up and down. There is a great variation in the size of the pupils. On some days they are inordinately dilated and in a subparalytic state, reacting only little and sluggishly to light and accommodation; on others they seem of normal size and reaction.

Acuity of vision and extent of the visual field are normal. So far as the patient's peculiar affection, to be described later on, will allow it, he reads the papers without difficulty. The only trouble, as he avers, is that when he glances hurriedly at the headlines the letters are apt to run together.

Occasionally twitches in the facial muscles on the left side are observed. The skin covering the left side of the neck is markedly wrinkled.

The symptoms now to be detailed are of a twofold nature: 1st, paralytic; 2d, spastic.

The whole left side is weak; the grip in the left hand, as ascertained by the dynamometer, is only one-half that of the right, on his bad days only one-third. The head, if unsupported, is apt to drop forward after holding it erect for some time. The left arm cannot be raised beyond the horizontal when abducted; he raises it easier, but not quite to a perpendicular line, when adducted. The left leg is considerably weaker than the right one.

Accompanying this hemiparesis there are contractures in the left upper and lower extremities. As in ordinary contractures (late rigidity) in hemiplegia due to hæmorrhage in the internal capsule, the flexors in the arm and extensors in the leg are chiefly affected. The position of the hand is characteristic. The fingers are clinched, the hand flexed at the wrist and pronated.

These contractures of hand and fingers are not permanent, however. Though with difficulty, the patient succeeds by a great effort of the will in extending the hand and opening the fingers. The latter process is a very singular one. The thumb, index, and third fingers are the first to obey the mandate of the will; after they have been extended a little while the fourth and fifth fingers follow slowly. The closing takes place in the inverse order: first, the fifth and fourth are flexed, then the others gradually close upon the palm of the hand. All these movements are executed reluctantly, as it were, on the part of the muscles.

He cannot keep the hand open except by the aid of the other hand or by pressing the palm against some flat object. There is also a tendency of the arm to be flexed at the elbow. This can be, however, easily overcome by the will.

The left leg is permanently extended at the ankle, and unless prevented from being so, by bracing the foot against some object, it stiffens at the knee. The foot is slightly inverted, the sole arched, the toes in the position of flexion characteristic of permanent contracture in late rigidity of common cerebral hemiplegia. The big toe presents the typical *hallux flexus* (hammer toe), the second, third, and fourth are flexed and abducted; the little toe turned inward under the fourth. A complete reduction of these contractures is impossible; being spastic in origin they have become organic by permanent shortening of the muscles of the calf. (Even in the chloroform narcosis during a subsequent operation they could not be reduced.) There is, then, talipes equino-varus of the usual type in spastic cerebral hemiplegia.

The right foot is nearly of the same appearance as the left, but instead of extreme flexion there is hyper-extension of the big toe and the varus complication is absent.

Both legs do not only stiffen and extend in the knees (unless prevented from doing so by mechanical means), but they also tend to flex in this stiffened state on the abdomen. Hence, the patient cannot lie on the back without the legs being in the air. Owing to this spastic stiffness in the knees he cannot cross the left leg over the right knee without the aid of the hands. The leg will stand out straight from, and at a right angle with, the body, until he grasps the foot by the heels and by pulling it toward the body, flexes the leg. The same may be said, though to a less degree, of the right leg. This he can cross over the left knee, but for some time the leg will remain in extension until it succumbs to the law of gravity and drops down, not suddenly, however, or at an even rate of quickness, but with intervals of arrest, after the cog-wheel fashion.

The spine is arched, the left shoulder, when standing erect, a little lower than the right; both conditions, however, can be almost completely corrected by an effort of the will. Though slowly and laboriously, the patient generally succeeds in straightening himself out.

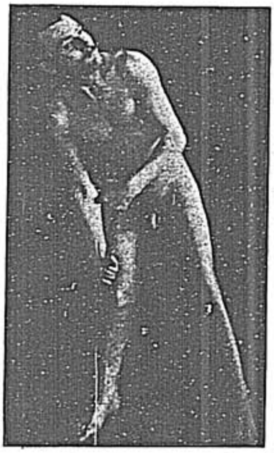
The abdominal muscles on either side are stiff and retracted, the left pectoralis hard and unyielding. In fact, almost the whole muscular apparatus of the body is in a state of rigidity of varying intensity. The right arm is the least affected of the extremities; the right side of the face seems to be entirely free.

Every voluntary movement is at once opposed by the simultaneous contractions of the antagonists. The effort to overcome the latter causes the odd appearance suggestive of the movements of an automatic wax figure. Owing to the constant counter-action of the antagonists he is unable, for instance, to shake his head, or with the good (right) hand to hammer a nail.

He experiences, however, occasional involuntary jerks in various parts of the body. These have been so violent at times that he has been in danger of being thrown from his chair.

During sleep, and especially when lying curled up in bed, the rigidity passes off, to reappear immediately on awakening and moving. Passive flexion and extension call immediately the antagonists into action.

FIG. 1.



The anthropoid walk.

His gait is of striking singularity. On several of his good days, perhaps three or four times within the last year, he has been able to go about for a short time without a stick. Ordinarily, however, he has to make use of this in order to move from place to place. In doing so he uses the right leg in spastic equinus position as a fulcrum, which he reinforces by the stick. This he grasps with the right hand, the right arm being extended in such a manner that the thumb is in front and the four fingers back of the stick. The palm of the left hand usually rests on the upper end of the stick. (See Fig. 1.) He now swings the left leg, which is in spastic extension, around and forward in a semicircle, with a kind of slide, scraping the floor; then, with a quick movement, he shifts the fulcrum (right foot and stick) forward, etc. All this while the head is turned to the left, the spine arched, the abdominal muscles retracted, the platysma wrinkled, the tendinous insertions of the sterno-cleido-mastoid muscle prominent. The extremely clumsy and uncouth appearance, and the long stick which he uses for the purpose of locomotion, suggest at once the *anthropoid* walk.

In the ward he prefers to shift himself about, utilizing the hook-like flexion of the index and third fingers of the left hand as a means of securing a hold on the iron bars of the bedsteads, using, of course, the right hand also. Of late, however, when necessity compels him to move about, he prefers to crawl on all-fours—to the water-closet, for instance.

In walking with the stick it takes him some time before he gets well started. The first few shuffling movements (one cannot call them steps) being made, the movements become somewhat easier, but he soon tires and becomes exhausted.

During the erect posture his feet are separated about one foot and a half, the weight of his body resting exclusively on the balls of the feet and the flexed toes.

He cannot walk with the feet naked on account of the pain occasioned by the pressure of the body on the tips of the toes.

Sensibility: There is no sensory disturbance of any kind; the patient recognizes, the eyes being closed, the slightest touch with the bedclothes, a sheet of paper, or the gentle blowing on any part of the body.

Reflexes: The superficial reflexes are all present. There is no difference between the right and left abdominal reflexes.

The knee-jerk would be, to say the least, brisk, if it were not for the antagonists preventing the excursion of the leg on tapping the tendon. That there is an increase can be demonstrated by the indirect tapping. The index finger being placed with the palmar aspect on the patellar tendon, the slightest tap on the dorsum which, under normal conditions would not produce a reaction, is followed by a distinct contraction of the quadriceps muscle. This method of demonstrating the exaggerated knee-jerk in spastic states of the muscle in which the excursion of the leg is prevented by the contraction of the antagonists, was demonstrated to me by Dr. S. Weir Mitchell on the occasion referred to above. The electrical reaction, both muscular and neuro-muscular, is normal. The mechanical irritability of the muscles, especially when in a spastic condition, is increased at times.

Spasms: In addition to the permanent and transitory contractures, he has distinct attacks of spasms of a peculiar kind. These vary in frequency and intensity just as his other symptoms do. There are days when he has one every five minutes; there are others when he has only ten or twelve. They are brought on by exertion and emotions, but they also occur spontaneously. He can bring them on himself by contracting certain muscles, but has also the power of controlling them to a limited extent. It is especially those that he brings on himself (for purposes of demonstration), but only to a small extent the spontaneous ones, that he can in a measure stop in their progress.

Beginning, progress, and nature of the spasms: They are initiated by a slight tremor of the head. They commence invariably in the muscles of the neck, and more specifically in the platysma myoides, as evinced by the deep creases seen in the skin covering it. The head turns slowly to the left, the eyes are closed, the left angle of the mouth retracted and depressed, the frontal muscle corrugated, the eyebrow arched.

At the same time, or a short time afterward, the arm, with the hand clinched and flexed, is extended and carried forward, then flexed and adducted so that the wrist and forearm grate the abdomen and lower ribs. Generally, however, he does not allow this movement to go through its entire course, but grasps the seat of the chair on which he sits in order to steady the arm.

Occasionally another movement takes the place of the one just described. The clinched fist is supinated, the forearm flexed on the upper arm. In this position the upper arm is raised by the muscles of the shoulder, and the forearm brought up to a level with the occiput, so that the fist rests on the latter. At this juncture the patient generally carries the arm over the head, and it gradually goes down by his side in a semiflexed position.

After the spastic movements of the arm, which, as stated above, occur often simultaneously with those in the neck and face, the left leg is extended at the knee, the talipes becomes more pronounced; it is flexed on the abdomen; after this the right leg is attacked, and the same muscle-groups as in the left enter into the state of contraction. The spasm never reaches the right arm, but a slight tremor is experienced in it and the right leg, winding up the series of the spasm.

Meanwhile the arching of the spine ordinarily present has become more pronounced, the trunk is rotated, the muscles of respiration are also involved. Breathing becomes for a short time impeded. The head is now retracted, and no more deflected to the left. The patient opens his eyes and the spasm abates in those muscles first in which it commenced, *i. e.*, in the muscles of the neck on the left side. Sometimes at this juncture the head slowly rotates to the right. Ordinarily, however, this rotation is voluntary, and resorted to for the purpose of relieving the muscles of the neck concerned in the spasm. Then, one by one, the other muscle-groups limber up to a certain extent, never entirely so. The order of the spasms is always the same. They never take place in the inverse direction, from the right foot to the left, for instance. They never extend beyond the right leg. These spasms are, as stated above, in a measure under the control of the will. They can be modified and lessened in their intensity. They can also be brought on voluntarily by the patient contracting the left platysma myoides, and inclining and turning his head to the left. Often they are aborted, the contractions remaining confined to the muscles of the left side of the head and left arm. The original locked spasm during which the left arm is drawn across the chest does not occur any more.

Consciousness has never been lost, or even dimmed. A frequent repetition of the spasms has a weakening but not absolutely paralyzing effect on the muscles involved.

Résumé: A brief recapitulation of the history, symptomatology, and the present state of the patient presents these features:

At first (three years ago) there is a spasm localized in the muscles of the left arm and neck. This, in the early stage of the disease, occurs periodically, twice a day. Later on, more frequently, and at irregular intervals. Six weeks later a contracture in the left foot sets in, and hemiparesis becomes manifest, together with contractures. Gradually the right leg becomes plastic. The spasms now attack in a serial order, or at least nearly so, various groups of muscles, starting invariably in the neck. All the symptoms, spasms, contractures and weakness, get progressively worse.

Clinical diagnosis: Cerebral paralysis (hemiparesis) with contractures, complicated with tonic intermittent spasms.

SEAT AND MORBID NATURE OF THE AFFECTION.—There can be no doubt as to the topical diagnosis. There is a well-known clinical picture which is vividly recalled by our case—that is, congenital cerebral spastic paralysis. The paresis, with contractures and the accompaniment of every emotion and physical exertion by spasmodic movements, stamps it at once as one akin to this form of paralysis. There are, indeed, some cases of infantile spastic hemiplegia which, barring the mental defect ordinarily accompanying it, present the identical motor disturbances of our case.

Unlike the ordinary cerebral hemiplegia with late rigidity in adults due to hemorrhage, our case commenced with spasms limited to the muscles of the head and arm on the left side. There was then, probably, an irritating lesion of some kind pressing either on the centres presiding over those movements, or their conducting fibres. This lesion, being a discharging one at first, must by slow growth have developed into a destroying one, causing paresis on the opposite side. Since the sensibility is everywhere intact, it stands to reason that this lesion (undoubtedly a coarse one) is high up in the motor tract, where there is an absolute separation of the motor and sensory tracts and centres. We have to look, therefore, as the probable seat of the lesion, not to the internal capsule, the common seat of coarse lesions, notably hemorrhage producing hemiplegia, but to a higher level, the corona radiata, or the cortex itself.

The steady but slow progress of the disease, the appearance of spastic symptoms first, and of the paralytic later on, suggests at once the existence of cerebral tumor of slow growth in or beneath the Rolandic region.

Again, the serial order of the tonic contractions justifies one in thinking of Jacksonian epilepsy, which, as is well known, is caused in the majority of instances by a coarse irritating lesion in the psycho-motor area. It is true, there are never any clonic spasms, no general convulsions, nor ever any loss of consciousness; yet, there is a distant resemblance to an epileptic attack of the Jacksonian type in the periodical spasms of our patient. As an old-time, sun-bleached daguerrotype still reveals the essential traits of the picture to one familiar with the person it represents, so there are here the indisputable elements of Jacksonian epilepsy.

Even idiopathic or genuine epilepsy, so called, presents in many instances, features which we find in our case. The rotation of the head, the retraction and depression of the angle of the mouth, the simultaneous locking of the arm, such as is produced by faradizing Erb's point, the closing of the eyes, the initiatory and concluding tremor, and finally, the impediment of respiration, are more or less suggestive of an epileptiform nature of the spasm. It is true, the tonic character of the latter throughout, and the absence of the clonic variety, stamp our case as quite an exceptional one. Still, reasoning by exclusion, and considering the fact that the spasms start always in the same group of muscles, a tumor in or near the centre presiding over those movements suggests itself.

There are two possibilities as to the seat of the supposed tumor. The history of the case, as given by the patient himself, would point to a region in the cortex in or near the centre for the movements of the arm and the rotation of the head. But a close observation of the patient during the spasms, and when free from them, shows that the contractions of the platysma and the flexion of the hand always initiate the spasm, and that in the aborted ones these movements alone take place. Hence, with great probability, we have to look to these centres or their immediate neighborhood as the seat of the lesion. These centres (platysma and wrist) are, as is well known, in close juxtaposition.

From here, as in the physiological experiment, the irritation travels upward, involving the centres for the movements of the shoulder, head, leg, and foot on the same side, leg and foot on the opposite side. Arriving at these centres the irritative force is exhausted, it seems. If it were to go beyond to the arm-centre, and to the centre opposite the one it started from, namely, that of the platysma, there would be, probably, general convulsions and loss of consciousness. These never occurred, as remarked before. But even the arm-centre for the right arm must be in an irritated condition, since there is an inhibition to all intended quick movements, the antagonists entering into activity immediately. There is also a tremor in it at the end of the spasm, denoting in all probability the ultimate radiations to this member of the discharge of accumulated nerve energy.

ABSENCE OF SYMPTOMS ORDINARILY ACCOMPANYING BRAIN TUMOR.—However, though the serial order of phenomena and the *signal* symptom (in the sense of Seguin), as manifested in the simultaneous contraction of the platysma myoides and the flexion of the wrist, point to the existence of a tumor in or near the respective cortical centre on the opposite side, one of the most important cardinal features of brain tumor is absent—headache. The patient has at no time suffered from it, except during a brief period of his career as a workman in a mining mill, where everybody was subject to this trouble. He never complains of it now. According to Mills and Lloyd, in only five of cerebral tumors has headache been missing.

He has never had vertigo, and as to the mental hebetude which generally accompanies brain tumor no trace can be discovered. He is a close observer and a good judge of his surroundings and of his own condition.

Yet, a mental peculiarity to which Wernicke[1] has called attention is present. He lacks initiative in conversation; he never commences one; but when addressed on a subject enters into it with intelligence and interest. It is also difficult to engage him in a conversation about a topic not connected with his case.

Again, the very pronounced form of contractures in this case of hemiparesis is suggestive of tumor, and the implication of the leg on the other side corresponds with the observations of Hughlings Jackson[2] on this point, who, as early as 1874, pointed out this fact as a peculiarity of hemiplegia caused by tumors. He designated it as the third degree of hemiplegia.

The contractures in our case are of the usual type, whether produced by hæmorrhage or tumor—*i. e.*, the flexors predominate in the arm, the extensors in the leg.

The question as to cortical or subcortical is hard to solve. Burdon Sanderson claims to have demonstrated that stimulation of different points in a horizontal section, through the deeper parts of the hemispheres, produces the same effects as stimulation of the so-called centres. This observation taken together with the hemiplegia with contractures, which, points to a destruction of conducting fibres, makes a subcortical seat probable.

Whether the contractures in a case of hemiplegia are always due to a descending degeneration, as Charcot maintains, seems to be as yet a mooted question. Besides, degenerative changes in the motor tract, irritative changes in the dura, and slight but continued irritations of the cortex may give rise to them.

All these considerations leave the cortical or subcortical seat undecided.

As to the histological nature of the supposed tumor only surmises are admissible. Glioma, fibroma, lipoma, a cyst, perhaps a cysticercus, may be thought of. With great probability it is not malignant.

But, as has been time and again stated by all competent observers, a diagnosis of brain tumor is hazardous, and remains doubtful until the existence of choked disk is demonstrated. The patient's sharpness and range of vision speak against such a complication. But after the tumor had been diagnosed and localized from other symptoms, an ophthalmoscopic examination, made by Dr. H. L. Wolfner, of this city, has revealed a beginning choked disk, which clinches the diagnosis.

The foregoing remarks, as stated above, were made at a meeting of the Medico-Chirurgical Society of this city. The diagnosis of partial choked disk was confirmed by Drs. Alt and Barck, and a consultation as to the advisability of an "exploratory craniotomy" was held with a number of prominent members of the St. Louis medical profession. No material objection was raised against the operation.

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[1] Gehirnkrankheiten, iii. p. 303.

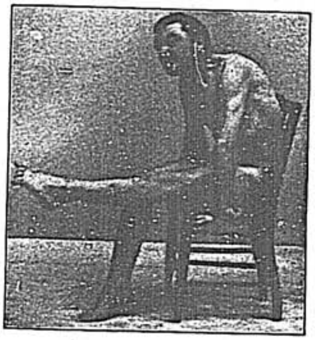
[2] British Medical Journal, July 25, 1874.

The question of operative interference was rendered especially difficult to solve by the fact that no case of this nature is on record. The literature does not show an instance, as far as I know, in which the symptom-grouping as described had led to an *intra-vitam* diagnosis of tumor; much less is an operation recorded. But taking all things into consideration, above all the progressive character of the lesion, and the declaration of the patient that he would prefer death to a life under such circumstances, the operation was deemed justifiable. It was not, as a matter of course, expected that a complete recovery was in the range of possibility. The tumor, or whatever other coarse lesion would be found, had necessarily destroyed brain substance enough in the motor area to set up some degree of descending degeneration. This could not be done away with, but its spread might be arrested by operation, and the very annoying spasms which made his existence almost insupportable might be eliminated, leaving the case as one of cerebral spastic paralysis, with a prospect of less impeded locomotion and prolongation of life.

EXPERIMENTS.—Experimentally the following results were obtained: The bromides, in doses of 90 to 100 grains, did not arrest the spasms, but made him feel more comfortable, provided physical exertions and emotional disturbances, such, for instance, as were connected with medical examinations, were avoided. Strychnine, $\frac{3}{16}$ of a grain daily, increased the number and intensity of the spasms, and made him feel weaker and generally miserable. Although there never was a decided paralysis after a spasm, a considerable degree of weakness could be demonstrated, principally in the left arm, on his bad days. The head also would, under such conditions, be more apt to drop. Unfortunately, no attempts at measuring the temperature over the supposed seat of the tumor were made. This omission is the more deplorable, as probably, in the light of later developments, positive data of diagnostic value might have been obtained.

Such positive results, however, were obtained with electricity. I will state at the outset that, like disturbances of any other kind, electricity, no matter how or where applied, would aggravate all the symptoms, and, if persevered in for any length of time, would insure a sleepless night. But discounting these general effects, certain modes of application to certain places could be demonstrated to be followed invariably by the same phenomena. Thus, whenever a faradic current strong enough to elicit muscular contractions from the motor points was applied to the left platysma myoides a typical spasm would result. The application of the same strength to the right platysma was without result.[1]

FIG. 2.



In a state of hemilateral spasm induced by faradic stimulation of the platysma myoides.

Again, wetting the scalp on the right side of the head, and applying a five-square-centimetre electrode, with a galvanic current of 3 to 4 milliampères interrupted 60 to 90 times a minute, to the area where, at a rough guess, the centres for the platysma, movements of wrist and fingers, and rotation of the head are situated, the same spasms of the same sequence were produced. The positive or negative pole was used, apparently with the same effect. The indifferent electrode was placed either to the left of the sternum or on the left side of the left scapula, in order to avoid the electrical excitation of such muscles as could of themselves be thrown into a tonic contraction by the stimulus, notably the left platysma and the muscles of the left arm. Counter experiments were made in sufficient numbers, and with the necessary precautions to exclude any possible sources of error, and the fact was established that faradic irritation of the left platysma myoides and a galvanic current interrupted from 60 to 100 times in a minute, applied over the cortical centres from which the spasms were thought to be originated, invariably gave rise to the same serial order of phenomena. Thus the faradic peripheral irritation of the "signal" muscle, and the transmission of the interrupted galvanic current through the motor "starting" centres, were capable of producing the identical spasms.

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[1] The spasm during which the photograph of the patient was taken was thus experimentally produced.

One fact may be expressly mentioned here, viz.: that a strong faradic current applied over the centres, the other electrode being on the opposite side of the skull, or at any other indifferent place—*i. e.*, not *particularly* liable to spastic contractions—did not yield any results.

Thus matters stood when, an exploratory trepanation having been determined upon, the head was shaved for craniometric purposes. To my great satisfaction an old scar was discovered about two and a half inches above, and a little back of the external auditory canal. The patient himself had been unaware of the existence of such a scar, and from its appearance the injury producing it must have dated back many years, possibly to infancy. This scar, about one-third of an inch in length, was about parallel to the sagittal line of the skull, not painful, and seemingly movable. This was an additional sign corroborative of a cortical lesion of the right motor area of the brain.

The electrical tests, most of them made in the presence of Drs. Herman and Wolfner, of this city, were now much more striking. It was demonstrated that the interrupted galvanic current applied just to, or in the immediate neighborhood of the scar, was, with unvarying regularity, followed by an attack of spasms. From the nature of the case these experiments, though sufficiently numerous to prove beyond a doubt the experimental facts as just described could not be continued long, or repeated often, since experience had taught me that one spasm predisposed the patient to another one, and he dreaded and disliked such experiments.

Another fact worthy of note was also evolved experimentally. The patient, as remarked at another place, had never during the course of his ailment complained of any trace of headache. The first application of the interrupted galvanic current (before his head was shaved) produced a pain at the seat of the application which extended to the forehead, and lasted half a day. During the subsequent electrical tests the same region was always more susceptible to the painful effects of electricity than any other.

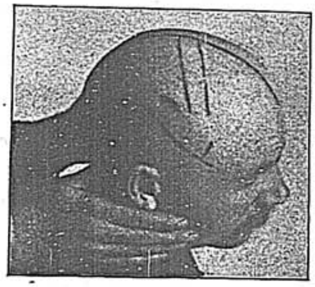
With the foregoing data on hand the patient was prepared for an operation.

Report of Operation. By Dr. Carson.

Joseph McE. was received into the St. Louis Mullanphy Hospital March, 1890. His general condition was good, and with the exception of the cerebral trouble his health was perfect. Immediately after his entrance into the hospital preparations for the operation were commenced. They consisted in warm baths at night, regulating the secretions, and shaving and washing the head.

March 26. The patient was brought to the operating table. One hour before he had had administered, *per os*, two drachms of fluid extract of ergot, and one-half hour before one-fourth of a grain of sulphate of morphine, subcutaneously. In the presence of a number of physicians and surgeons of this city, an Esmarch band having been applied around the head, and under the most strict antiseptic precautions, the operation was commenced. The site of the scar, shown in the accompanying cut[1] (Fig. 3), was marked on the bone by a small drill hole. The surface of the cranium was then exposed by a rectangular flap, including the pericranium, three inches broad by four inches in length, with its base forward. The pin of an inch and a half trephine was then applied at the site marked by the bone-drill, and a corresponding button removed.

FIG. 3.



Showing the fissure of Sylvius and the fissura Rolandi, drawn with the aid of Wilson's cyrtometer. The dark spot at the angle formed by the convergence of the fissure of Sylvius and fissura Rolandi represents the site of a small cicatrix which has been enlarged about four or five times by applying lamp soot. The line anterior and parallel to the fissura Rolandi represents the præfrontal sulcus.

This was a task of some difficulty, on account of the temporal ridge being included in the circle of the trephine. Upon the removal of the disk of bone the dura mater bulged boldly into the opening. This was slightly opaque, and all normal pulsation, both on inspection and palpation, was absent. The trephine opening was then enlarged by the rongeur forceps until it was about two inches square. As the dura was removed the brain pushed rapidly through the incision and protruded nearly an inch beyond the outer surface of the cranium. The vessels of the pia covering this protruding mass were enlarged, turgid, and tortuous, while the cortex underneath presented a reddish-brown appearance, and was readily compressible, and would rapidly refill after having been compressed.

The tumor could be outlined on three sides, above, below, and behind, while in front it seemed continuous with healthy brain substance. An exploring needle was introduced to the depth of an inch and a half, when it seemed to meet with more resisting tissue. Its withdrawal was followed by a flow of serum, and afterward by pure blood; this in turn was followed by a partial collapse of the tumor, but it was only of momentary duration, as it soon became tense as before.

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[1] The size of this scar is much exaggerated in the picture, it being in the original very small and indistinct.

Wishing to increase the size of my opening somewhat I again used the rongeur, and in so doing, unfortunately, my forceps slipped and lacerated the surface of the presenting tumor. According to the statement of one of my colleagues, this was followed by an escape of a considerable quantity of reddish-brown fluid, which I did not see. Free bleeding followed from the lacerated surface, which could only be controlled by compression. This surface was of a dark reddish-brown color. The finger introduced into this laceration entered to the depth of about a half inch or more, and took a direction forward about an inch, when it entered a cavity the size of a small hickory-nut, with smooth walls, and which seemed to be surrounded with healthy brain substance. Then, with the handle of an old spoon, sharpened by long use, I proceeded to remove the protruding mass, which was exceedingly friable, breaking down rapidly, and coming away with the utmost facility. This procedure was continued until apparently healthy tissue of normal consistency was reached. Macroscopically the mass removed presented a mottled, dark-brown, yellowish, and partly gelatinous appearance. Some of the pieces seemed to consist of brain substance traversed by dense punctiform hæmorrhage, whereas others were made up of a dark-red shreddy material (no doubt stroma of the cavernous angioma, subsequently diagnosed by the microscope). This included, for the most part, the cortex, but extended also into the subcortical region. The part removed was about the size of a large walnut, and made quite a cavity, which was rapidly filled by healthy brain matter. After the removal of all the diseased tissue the surface was cleaned, and a rubber drainage tube introduced to the bottom of the cavity. The dura mater was then replaced, and sutured with a continuous catgut suture. The trephine button and bone clippings, which had been preserved in warm bichloride cloths, were then replaced, the button being attached to the flap with catgut sutures. Three horse-hair drains were put in position under the flap, which was closed with a continued catgut suture. A slight bichloride gauze dressing was applied over all, and the patient returned to bed.

The operation lasted two hours, and when completed the condition of the patient was not good. During the operation much blood was lost, not from any one or more distinct points, but from a general oozing from the entire surface of the wound in the brain. This bleeding was not controlled in the least, either by the application of hot water at 120° Fahr., or by the application of a ten per cent. solution of cocaine. The patient was returned to bed, the feet elevated, and a subcutaneous injection of digitalis and brandy given, and warmth applied. The operation was completed at about 1 o'clock in the afternoon, and at 5 o'clock the patient had partially reacted. By 10 o'clock P. M. reaction was complete.

It will not be necessary to go into a detailed account of the progress of the case. Suffice it to say that the convalescence was uninterrupted, the highest temperature reached being 99.6°. The rubber drain was removed at the end of forty-eight hours, and the horse-hair drains at the end of the third day.

The improvement in the patient's symptoms has been most decided, the spasms having entirely disappeared since the operation. Three days after the removal of the tumor the evidences of paralysis, noted by Dr. Bremer, were exaggerated, but no new groups of muscles were involved. There was complete loss of power of the muscles of the back of the neck, and the power of raising the left arm to the head was lost, as was also the ability to extend the left hand, which had completely lost its grip, Anæsthesia was complete in the arm and over the platysma, partial in the left side of the face. This condition was unchanged two weeks afterward. At present, five weeks after his admission into the hospital, the patient sits up in bed, moves himself freely without assistance, and has regained to some extent the use of all the muscles paralyzed by the operation.

There has been no return of the spasms. The only evidence of his previous condition remaining is a slight spasticity in the legs, more marked in the right than in the left. He is now able to lie in bed upon his back, extended to his full length, a condition impossible before the operation. There is a loss of muscular sensibility in the left hand, most pronounced in the fourth and fifth fingers, which are, moreover, almost completely anæsthetic, only a sharp pinch or a deep prick with the needle being perceived. General sensation, to wit, sense of pain, pressure, and temperature, is also impaired in the three remaining fingers, least of all in the thumb, in which, however, as in the rest of the fingers, the muscular sense is entirely absent. In an effort at locating the seat of the pain produced by the prick of a pin, he makes frequent mistakes, least so when the thumb is the object of experiment. In addition to the fourth and fifth fingers the ulnar side of the hand and three-fourths of the arm are paralyzed.[1] At first there was a slowness in answering questions; apparently he had to collect his words before he could reply, but after his sentence was made up there was no hesitation in utterance. This has all disappeared, and he now replies to questions promptly and without delay.

The scalp wound completely healed in less than a week, and at present shows little evidence of the injury inflicted, the replaced bones having apparently united, as the surface of the cranium is smooth and solid, and it is with much difficulty that the site of the operation can be made out.

The fissure of Rolando was located by two different methods. First, by Thanes's method, and then with a Wilson's cyrtometer. The fissure of Sylvius was located by the usual method. The scar was found to lie at the lower end of the ascending parietal convolution, as indicated by the accompanying diagram, corresponding to the platysma-centre in Ferrier's scheme. The intention had originally been to trephine midway between the platysma and the head-centre—*i. e.*, in a line from the lower end of the ascending parietal obliquely forward and upward. The finding of the small scar changed the plan.

So far as I was able to determine, the cavity in which I introduced my finger involved a part of the ascending frontal convolution, extending somewhat into the base of the second frontal convolution.

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[1] There is now, in the seventh week after the operation, a slow return of tactility and muscular sensibility.

The following conclusions were drawn from the results of the operation: First, that the Esmarch bandage completely controlled the hæmorrhage from the scalp wound. Second, that the administration of ergot (*per os*) and morphine subcutaneously must have had a very decided influence upon the hæmorrhage from the brain surface; although this was considerable, it was nothing to what we should have expected, considering the nature of the tumor, had not some influence been exerted upon the vessels by the drugs. Third, that the application of ligatures to the vessels in the brain substance is not such a difficult task as we are led to believe from reports; the forceps held well, and with care the ligatures were applied without difficulty. Fourth, that the cocaine solution, ten per cent., and hot water at 120° Fahr., applied to the bleeding surface, exerted no influence whatever in checking the hæmorrhage; pressure was the only means that seemed to control it in the least. Fifth, the impressions conveyed to the finger by the tumor are worthy of note. The whole tumor could be entirely compressed, and felt much softer than the surrounding brain substance. While there was not the slightest approach to fluctuation, yet the feeling was that of a fluid displaced by the pressure; upon removing the pressure the tumor rapidly refilled, and presented through the cranial opening.

The masses removed by the operation consisted partly of shreds of reddish-brown appearance, partly of fragments of brain substance of variable appearance. While most of it bore a mottled aspect, caused by brown spots of varying size and separated by the intervening brain substance at different intervals, other pieces looked more homogeneous and gelatinous-like.

The whole mass, as removed, was collected in Müller's fluid, and a microscopical examination showed that the coarse lesion producing the peculiar symptoms in Joseph McE.'s case was an *angioma cavernosum.*

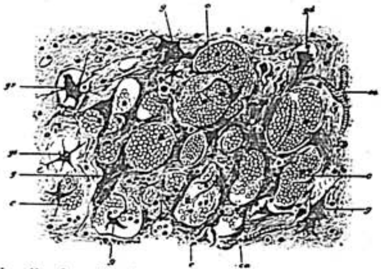
CONCLUDING REMARKS BY DR. BREMER.

MICROSCOPICAL EXAMINATION.—Many sections of the brownish mottled-looking particles of brain, representing cortical and a small amount of subcortical layer, were made vertically and some horizontally to the brain surface. Without staining, and examined simply in water or glycerin, the sections exhibit round and irregular brown spots of varying size, some with fluted outlines, interspersed in seemingly normal brain substance, both in the cortex and in the subcortical regions. Some sections look perforated because the brownish masses, which are made up of blood, have fallen out; these sections have a meshy, or, as it were, a worm-eaten appearance. In other specimens a fan-like arrangement of the brownish masses, radiating from the depth to the periphery, can be seen. (Elongated caverns run parallel to the radiating nerve-fibres and vessels in the subcortex.)

Of the various staining substances tried, an aqueous solution of gentian-violet gives the best and most characteristic pictures, a bluish mass (the brain substance), dotted with round and irregular yellow spots (the blood in the caverns). Whereas in the depths of the tissue, pointing toward the radiating crown, loose, irregular meshes of a longitudinal arrangement (parallel to the course of the cortical and subcortical blood-vessels) can be demonstrated, filled with blood, the character of the morbid mass changes higher up in the cortex, wherever this is involved —and in the vast majority of sections examined it is. There, in the cortex—and for that matter, in the subcortical conducting substances, whenever moderately involved in the pathological process—the genesis of the latter can be seen. The blood circulating in the main mass of the spongy tumor in the deeper parts of the brain, in its endeavor to expand to the higher and neighboring districts, utilizes the preformed lymph spaces surrounding the cortical and subcortical arterioles, establishing an ever-expanding extra-arterial current. The same obtains in the lymph-spaces of some capillaries. Owing to the peripheral pressure thus produced by the extra current of blood the vessels are in some places compressed, in others atrophied and reduced to a thin, irregular thread; in still others completely obliterated. In the more advanced stages of the pathological process the surrounding brain substance forming the interspace of the respective vessels atrophies, and the remnant now appears as partitioning walls of the caverns filled with blood. Thus a sponge-like arrangement results in those places where pressure and consecutive atrophy of the brain substance have been most pronounced. There is no cell-lining to the caverns. In some instances the cortex has entirely disappeared and the blood caverns extend to the surface, separated from the pia mater only by an exceedingly thin strip of an amorphous substance.

The giant pyramidal cells in the neighborhood of the caverns have, through pressure, changed their forms to the spindle shape; others have conformed to the new order of things, and their lymph spaces having been invaded by the blood-stream, they have become part and parcel of the meshwork or stroma, as it were. Under these circumstances they have adapted their shape to the new requirements, their processes describe arcs and seem to interlace with the processes of the neighboring ganglionic cells (after the fashion of the branches of two neighbor trees). Some of the ganglionic cells are characteristic for the comparatively intense tint which they have assumed, denoting that the micro-chemical reaction to the staining material is more active in them than in the rest of the cells of the same kind. Is this deep stain due to a chemical change in the protoplasm caused by functional hyperactivity? And is the latter caused by the overgreat amount of the nourishing fluid in which they are, so to say, constantly bathed? These seem to me legitimate questions to ask, but they cannot at present be definitely solved. In looking at some of the ganglionic cells in Fig. 4, one is struck by their resemblance to the spider-cells found in the various chronic inflammatory cortical affections. This would seem to lend support to Kleb's view, who regards the spider-cells as degenerated ganglionic ones.

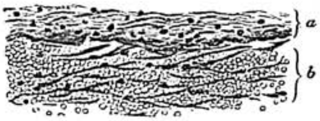
FIG. 4.



g. Ganglionic cells of varying shapes; some have adapted themselves, by pressure, to the contours of the blood caverns, practically forming part of their walls or stroma. *gd*. A degenerated ganglion cell. *gs*. Ganglionic cells approaching the spider-cell type. *c*. Caverns filled with blood. *ca*. Capillaries.

The masses removed and examined come, no doubt, from the lower end of the ascending parietal convolution. In this, we know, the giant pyramidal cells are to be found only in the immediate neighborhood of the central fissure, whereas the hind portions of the convolution are devoid of such cells. From my specimens I conclude that only a small

FIG. 5.



a. Layer of compressed and necrosed brain substance. *b*. Tumor mass showing the stroma.

part of the cortex near the central fissure is represented in the removed mass, the main bulk coming from the posterior part of the ascending parietal. This conclusion is based on the absence of the giant-pyramidal cells in the vast majority of the tissue-pieces examined.

In some portions the cortical, and to a varying extent, the deeper masses have lost their structural peculiarities; the pyramidal cells and (subcortically) the medullated nerve-fibres have disappeared and a finely granular and reticulated tissue, dotted to a varying degree with round cells, has taken their place. It is atrophied brain substance. There is also evidence of inflammatory activity in some parts, there being round-celled infiltration, especially around necrosed islands of brain tissue.

Angiomata of the brain are not very rare tumors. Mills and Lloyd[1] mention their occurrence, but do not speak of angiomata cavernosa. As a rule, cerebral angiomata are congenital; there is no new formation of vessels, but simply a telangiectasis. In this case there was possibly at first such a congenital angioma, which under strain ruptured, the blood suddenly inundating the neighboring peri-arterial lymph spaces. The sudden increase in the growth was great enough to produce a discharge of nerve energy in the shape of a locked spasm, but it was not large enough to act as a destroying lesion. This took place later on when the patient began to limp. Since he grew gradually but constantly worse, it stands to reason that the tumor was constantly growing. The final result would probably have been rupture of the whole mass and death of the patient by apoplexy. Was the injury which produced the scar concerned in the production of the angioma, or was it only an incident that this insignificant remnant of a very old trauma happened to be found in the region where the tumor had been located? And with which arterial system did the meshwork communicate? The radiating and fan-like arrangement alluded to above, points to branches of the lenticulo-striate artery.

GENERAL CONSIDERATIONS.—The one clinically recognized form of disease which our case resembles more than any other is infantile spastic hemiplegia. In this, as in our patient, the spastic symptoms often overshadow the paralytic ones. These spastic phenomena, the irritative contractures, as well as the involuntary movements accompanying, or even preceding, not only bodily movements, but also emotion and speech, we meet with in this case. But, instead of being post-hemiplegic motor disturbances, as they ordinarily are, they occurred before any decided hemiplegia set in—*i. e.*, they were *pre*-hemiplegic. There were first mono spasms, afterward hemiplegia.

The articulatory disturbances are not exactly such as one finds in the infantile forms of spastic hemiplegia; but there is in some cases of this disease a peculiarly explosive form of speech, accompanied by spastic movements of a tonic nature, in the face and various parts of the body, which reminded me very much of the patient's articulatory defect.

One word about the serial order and the frequency of the spasms. Hughlings Jackson, the ingenious observer of the kind of epilepsy which bears his name, takes it to be an explosive discharge of the ganglionic cells which are overloaded with nutritive material, and attributes it to the irritation and hyperæmia existing in the neighborhood. It is probably owing to this extreme degree of blood-supply, caused by the angiomatous character of the superficial substance of the cortex, that the frequent discharges took place, as evidenced by the tetanoid contractions and the serial spasms. It is, perhaps, rather hazardous, but I cannot forbear to suggest a possible causal relation between the peculiar forms and chemical behavior toward the staining agent on the one hand, and the spasms on the other.

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[1] Tumors of the Brain, etc. Pepper's System of Medicine, p. 1049.

The frequency of these discharges explains further the almost exclusive occurrence of tonic—*i. e.*, milder—spasms, the clonic ones requiring, as it were, a larger amount of stored-up energy. The contractures which, it had been hoped, were due, before the operation, to irritation of the dura mater, or the cortex, owe probably their origin to a descending degeneration. Such, at least, is the inference from the existence of the considerable defect of subcortical nerve substance.

The final developments in this case tend to verify Seguin's view as to the distinguishing symptoms between strictly cortical and subcortical tumors: "In favor of subcortical location of tumor (speak) local or hemiparesis, followed by spasm; predominance of tonic spasm, absence, small degree or very late appearance of local headache and of tenderness to percussion." (*Med. Record*, Feb. 13, 1886.)

The facts stated elsewhere that the left fingers, and partly the hand and the ulnar side of the arm, are anæsthetic, and that the fingers have lost their muscular sensibility, and that the platysma region was for weeks completely without sensation, whereas the face felt only numb, are, perhaps, calculated to throw some rays of light on the vexed question as to whether, and to what extent, the motor centres subserve, beside motion, tactility and muscular sensibility.

It will be remembered that before the operation there was not the slightest evidence of any sensory disturbance noticeable about the patient. The simultaneous abolition of sensation in the platysma region, and in the fingers and part of the hand and arm after (at any rate partial) ablation of their motor centres, would, to say the least, go to prove that the sensory cortical areas for regions which are outwardly so far apart as the platysma and fingers, and whose motor centres are so close together in the cortex, must be situated in close proximity. The paresis (before the operation) without any involvement of sensation, speaks in favor of differentiation in the cortex; the paralysis with anæsthesia after operation (removal of a comparatively small area) points to a more or less common cortical seat of motor and sensory functions. If these sensory areas (including tactile and muscular sensibility, and sense of pain and temperature) are at all separate from the motor centres, they must be immediately behind their respective motor areas. Now, it seems pretty certain that the function of voluntary motion resides only in those parts of the cortex in which the giant pyramidal cells are met with; again, the larger part of the diseased brain mass, subjected to a microscopical examination, does not contain them, and is consequently derived from the posterior portion of the lower part of the ascending frontal convolution, possibly in part from the anterior margin of the parietal lobe, and the loss of sensibility might be explained on this ground.[1]

Taking everything into consideration, I am inclined to favor Starr's view, who asserts "That perceptions occur in the gray matter of the cortex of the central region and parietal convolutions, and that the various sensory areas for the various parts of the body lie about, and coincide to some extent with the various motor areas for similar parts, but the sensory area is more extensive than the motor area, extending into the parietal behind the motor area, which is confined to the ascending frontal and parietal convolutions."

The patient cannot tell when his fingers are passively flexed or extended. He feels a sharp pinch, or the prick of a pin, but he cannot locate it. Therefore, muscular sensibility and the faculty of locating cutaneous impressions (tactility) must have common centres that lie close together. It is probable that a considerable portion of the centres for the fingers was removed, the trephine hole having been made, in my opinion, rather above the platysma centre; and yet the grip is now pretty good. Is it owing to substitution centres that motor power is returning, or are we permitted to think of a *lower* centre as presiding over these coarse motions? The fact that he cannot move a finger alone, but has to flex or extend them all, might, perhaps, speak in favor of such a supposition. The thumb-centre seems to have suffered least, since he can move it in every direction, and since tactility is demonstrable to some extent.

The statement will be remembered that the ring and little fingers were weaker than the index and middle ones. The operation intensified this weakness, and in the same degree corresponding to the extent and severity of the paralysis, impairment of sensation took place. *Pari passu* with motion, sensation returns. The index and middle fingers were, after operation, as they had been before, his best, both as to motor power and sensation.

Recent experiments of Ferrier, Horsley, and Schäfer, place tactility in the limbic lobe. The facts in our case cannot well be reconciled with such a view, unless we assume that, in introducing his finger into the cavity, the surgeon injured the sensory conducting fibres going to that locality, but it would be hard to understand how only those for the fingers and the platysma could have been injured.

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[1] The possibility must be admitted, however, that cortical substance not possessing the structure characteristic of the motor areas may, after all, be endowed with motor functions, especially in fields for such weak muscles as the platysma, perhaps respiratory and abdominal muscles, etc.

The exacerbation of all the symptoms on physical exertion and emotion is easily explained in this way: The tumor amounted practically to a blood-cyst, which communicated with the arterial system. Any increase in the activity of the heart (exertion and emotion) necessarily increased the supply of blood to the cyst, increasing the pressure and stimulating the ganglionic cells.

A later history of this case will be published in due time.

RESPIRATORY PARALYSIS AFTER DIPHTHERIA AS A CAUSE OF PULMONARY COMPLICATIONS, WITH SUGGESTIONS AS TO TREATMENT.

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ASSISTANT PHYSICIAN TO THE MIDDLESEX HOSPITAL; PHYSICIAN TO THE NORTHEASTERN HOSPITAL FOR CHILDREN.

A perusal of some of the literature of diphtheritic paralysis leads me to think that too little attention has been paid to the effects of paralysis of the muscles of respiration on the movements of the chest and to the affections of the thoracic viscera which may result therefrom.

That the muscles of ordinary respiration are liable to this form of paralysis is presumably accepted by every one; yet I have been surprised to find how comparatively few observers have recognized this complication, even in hospital practice, where it should be relatively frequent. Moreover, the condition is not absolutely rare, seeing that in the course of the last four years at least fifteen cases of it have come under my personal observation.

Recent writers on diphtheria, whilst discussing at length the varieties of cardiac paralysis, say little or nothing about the effect of diaphragmatic or intercostal paralysis on the lungs, and through them on the pulmonary circulation and the heart.

This paper is the outcome of observations made on fifteen cases of diphtheritic paralysis in which the muscles of ordinary respiration, especially the diaphragm, became more or less involved. Thirty-four consecutive cases of the disease, treated in the wards of the North-eastern Children's Hospital, furnish thirteen of these. One case, which occurred in 1886, first drew my attention to the subject; the others occurred more recently. They are distributed as follows: One case in 1886, five in 1888, and nine in 1889. I have met with only one doubtful case during the present year, although several patients with diphtheritic paralysis have been under treatment in the hospital.